Microgravity

Marshall Space Flight Center CDDF Success Story Number 2

A Diode-Laser Holographic Imaging System Applied to the Study of Fluids in Microgravity

The work supported in this CDDF project concerned the development of a compact, state-of-the-art, modular holographic imaging system, based on laser-diode technology.

Holography is an important research method because it records a three-dimensional image of the entire volume of a test cell. Construction of a hologram records the wavefront coming from the test cell. Reconstruction of the hologram reproduces the same wavefront. Analysis of the experiment is the same whether performed on the reconstructed wavefront from the hologram or the original test cell. This capability is important in many areas of research, such as solution crystal growth, fluid physics, and particle phenomena.

The miniaturized holographic system flew on the KC–135 aircraft to test its capabilities. The system successfully took holograms of a variety of fluid experiments. The device has applications in ground-based laboratories, as well as in reduced gravity environments, such as the Space Shuttle, the KC–135 aircraft, sounding rockets, and the Space Station. Holographic systems have already flown on the Shuttle in the Spacelab. However, the systems are large in size and typically take up multiple Spacelab racks. The miniaturized system can fit inside a single Shuttle locker.

The results of this work are directly applicable to the RTOP "To Further Investigate the Influence of Microgravity on Transport Mechanisms in a Virtual Space Flight Chamber." One of the objectives of this RTOP is to design a new space flight experiment that would be superior to any existing flight hardware in its capabilities to both monitor critical crystal growth parameters and directly measure microgravity effects such as residual gravity and g-jitter.

The development of a holographic system based on current miniaturized optics technology was possible as a result of the CDDF support for this project. The information gained from this study will be directly applied to the design of a new space flight experiment.